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ABSTRACT

The Council of Chief State School Officers has established a system of state and national indicators for the condition of science and mathematics education. This policies report is based on a survey of all state departments of education conducted in the 1991-1992 school year. An introductory section provides the rationale and background for studying state education policies. The next section of the report provides 50-state information on the current state policies on graduation requirements, curriculum frameworks, student assessment, and teacher certification requirements. Thirteen tables are utilized to present this information. Two appendices describe efforts to implement state mathematics and science frameworks or guides in 1991. (Contains 25 references.) (MDH)

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STATE POLICIES ON SCIENCE AND MATHEMATICS EDUCATION 1992

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Council of Chief State School Officers
State Education Assessment Center

Science and Mathematics
Indicators Project
May 1992

STATE POLICIES ON SCIENCE AND MATHEMATICS EDUCATION 1992

Rolf K. Blank
Melanie Dalkilic

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The Council of Chief State School Officers (CCSSO) is a nationwide non-profit organization of the 57 public officials who head departments of public education in every state, the District of Columbia, the Department of Defense Dependent Schools, and five extra-state jurisdictions. CCSSO seeks its members' consensus on major education issues and expresses their view to civic and professional organizations, to federal agencies, to Congress, and to the public. Through its structure of standing committees and special task forces, the Council responds to a broad range of concerns about education and provides leadership on major education issues.

The State Education Assessment Center is a permanent, central part of the Council of Chief State School Officers. This Center was established through a resolution by the membership of CCSSO in 1984.

The Science and Mathematics Indicators Project is a cooperative effort of the Council with all of the state departments of education, the U.S. Department of Education, and the National Science Foundation to collect and periodically report data on the condition of science and mathematics education in elementary and secondary schools. The state policy information in this report was obtained through the cooperation of the state supervisors of mathematics and the state supervisors of science.

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STATE POLICIES ON SCIENCE AND MATHEMATICS EDUCATION: 1992

Improving student learning in mathematics and science is a high priority for our elementary and secondary schools. The national educational goals of the President and governors, set in 1989, state that science and mathematics achievement of American high school graduates will be first in the world by the year 2000. In September 1991, the National Education Goals Panel recommended measures to be used in tracking progress toward the goals and reported baseline data on several measures. The Panel set high expectations for improving the quality of science and mathematics.

The Council of Chief State School Officers has established a system of state and national indicators of the condition of science and mathematics education, through support of the National Science Foundation. The 1990 Council report on indicators of science and mathematics education provided the first state-by-state comparative data on student course taking in science and mathematics as well as the characteristics and qualifications of science and math teachers (Blank and Dalkilic, 1990). A part of the state indicators effort is periodic reporting on trends in state policies related to science and mathematics education. The first state policies survey was conducted in 1987. This policies report is based on a survey with all state departments of education conducted in the 1991-92 school year. The report provides 50-state information on the current state policies on graduation requirements, curriculum frameworks, student assessment, and teacher certification.

STUDYING STATE EDUCATION POLICIES

In the early 1980's, states took the lead in responding to the national studies and reports recommending reform of our education system (National Commission on Excellence in Education, 1983; Task Force on Education for Economic Growth, 1983; Twentieth Century Fund, 1983; Goodlad, 1984). The report of the National Commission on Excellence in Education, A Nation at Risk: The Imperative for Education Reform, probably received the most attention and response. The Excellence Commission deplored a "rising tide of mediocrity" in our education system and identified specific problems in the areas of science and mathematics. The report noted the poor performance of American students on international assessments in science and mathematics, declining average scores on national achievement tests, and the relatively small amount of science and mathematics instruction received by the average American student. National commission reports also highlighted the problem of underqualified teachers in science and mathematics and impending teacher shortages in these subjects (National Science Board Commission on Precollege Mathematics, Science, and Technology Education, 1983; Carnegie Forum on Education and the Economy, 1986).

Legislatures and boards of education in virtually every state approved policy initiatives aimed at improving the quality of education. The states increased course credit requirements for graduation (particularly in mathematics and science), raised standards for teacher preparation, mandated teacher tests for certification, set higher levels for teacher pay, developed state curriculum guidelines and frameworks, and established new statewide student assessments (National Governors Association, 1986). Studies conducted in the late

1980's analyzed and reported on the types of policy changes made by states (Education Commission of the States, 1984, 1987; Goertz, 1988; Fuhrman and Malen, 1991).

Since 1987, the Council of Chief State School Officers has produced an annual report, State Education Indicators, which includes state education policies. The Science and Mathematics Indicators Project of the Council surveyed states on policies in science and mathematics in 1987, and reported on policy changes in science and mathematics during the 1980's (Blank and Espenshade, 1988; CCSSO, 1989).

Since the studies of the "first wave" of state policy reforms in the 1980's, there have been other policy initiatives by states. Many states have recently begun planning and implementing changes in their student assessment programs toward use of alternative methods of assessing student learning, such as performance assessments, portfolios, and open-ended questions (Roeber, 1991). A majority of states have established alternative routes for teacher certification and licensure as a means of attracting talented individuals into teaching (Feistritzer and Chester, 1991). Most states have developed or revised state curriculum frameworks or guides in response to the Curriculum and Evaluation Standards of the National Council of Teachers of Mathematics (1989).

To provide current information on state policies in science and mathematics, the Council initiated a new survey in 1991-92. The purpose of the new survey was to update the status of state policy changes made in the 1980's as well as more recent state education policy initiatives. The survey was sent to all state supervisors of science and mathematics education in December 1991, and they were asked to update existing policy information on graduation requirements, student assessment programs, and teacher certification. New

questions were answered about state curriculum frameworks, new requirements for teacher certification, and requirements for professional development of teachers. Council staff conducted mail and telephone follow-up contacts to verify the accuracy of information for each state.

SCIENCE AND MATHEMATICS POLICIES: 1992

State Graduation Requirements

The National Commission on Excellence in Education recommended that three mathematics and three science courses be required for high school graduation and that science be made a "new basic" in elementary school (1983). One of the policy initiatives taken by many states in the 1980's was increasing the number of course credits in mathematics and science required for graduation. From 1980 to 1984, 36 states increased the number of credits required in math and 33 increased the number in science (ECS, 1984). From 1984 to 1989, eight more states increased the number of credits required in math and seven increased the requirement in science (CCSSO, 1989). In addition, in the 1980's, 12 states established an advanced or honors diploma that requires additional, higher-level courses in science and mathematics. Several studies have analyzed the effects of increased graduation requirements on course taking in science and mathematics (Cagampang, H. and Guthrie, J.W., 1988; Clune, 1989; Clune, et al., 1991; Blank and Dalkilic, 1990). In general, the studies found that higher state requirements have raised the amount of course taking in math and science, but the increases have been greater for lower-level courses.

Table 1
STATE REQUIREMENTS IN MATHEMATICS AND SCIENCE FOR HIGH SCHOOL GRADUATION: 1992

	CREDITS FOR A REGULAR DIPLOMA		CREDITS FOR ADVANCED/HONORS DIPLOMA	
STATE	MATH	SCIENCE	MATH	SCIENCE
ALABAMA	2	2	3	3
ALASKA	2	2	–	–
ARIZONA	2	2	–	–
ARKANSAS	*5 combined*		–	–
CALIFORNIA	2	2	–	–
COLORADO	*Local board*		–	–
CONNECTICUT	3	2	–	–
DELAWARE	2	2	–	–
DISTRICT OF COLUMBIA	2	2	–	–
FLORIDA	3	3	4	4
GEORGIA	2	2	3	3
HAWAII	2 (3, '97)	2 (3, '97)	3	3
IDAHO	2	2	–	–
ILLINOIS	2	1	–	–
INDIANA	2	2	4	3
IOWA	*Local board*		–	–
KANSAS	2	2	–	–
KENTUCKY	3	2	4	3
LOUISIANA	3	3	–	–
MAINE	2	2	–	–
MARYLAND	3	2	3	3
MASSACHUSETTS	*Local board*		–	–
MICHIGAN	*Local board*		–	–
MINNESOTA	1 *Local board*	1	–	–
MISSISSIPPI	2 (3, '95)	2	–	–
MISSOURI	2	2	3	3
MONTANA	2	2	–	–
NEBRASKA	*Local board*		–	–
NEVADA	2	2	–	–
NEW HAMPSHIRE	2	2	–	–
NEW JERSEY	3	2	–	–
NEW MEXICO	3	2	–	–
NEW YORK	2	2	2 Regents Courses	2
NORTH CAROLINA	2	2	4	4
NORTH DAKOTA	2	2	–	–
OHIO	2	1	–	–
OKLAHOMA	2	2	3	2
OREGON	2	2	–	–
PENNSYLVANIA	3	3	–	–
RHODE ISLAND	2	2	3	2
SOUTH CAROLINA	3	2	–	–
SOUTH DAKOTA	2	2	4	4
TENNESSEE	2	2	3	3
TEXAS	3	2	3	3
UTAH	2	2	–	–
VERMONT	*5 combined*		–	–
VIRGINIA	*5 combined*		3	3
WASHINGTON	2	2	–	–
WEST VIRGINIA	2	2	2 Advanced Courses	–
WISCONSIN	2	2	–	–
WYOMING	*Local board*		–	–
TOTAL	2.5-3 credits = 13 states 2 credits = 31 Local = 7	2.5-3 credits = 6 states 2 credits = 36 1 credit = 2 Local = 7	17 states	16 states

– No State Requirement

Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

The results of the 1992 state policies survey show that since 1989, a few states have made further increases in science and mathematics requirements. One state (Montana) raised the current science requirement to two credits. Two states, Hawaii and Mississippi, passed legislation to raise requirements for future graduating classes. Perhaps most significant, five more states have established an advanced or honors diploma which specifies additional, higher level courses in science and math.

Mathematics credit requirements:

- 10 states require three Carnegie credits in mathematics,
- 3 states require two math credits and one additional credit in science or math,
- 31 states require two credits in mathematics,
- 7 states leave the policy decision on course credits to local districts, and
- 17 states have an advanced or honors diploma that requires additional, higher level courses in mathematics.

Science credit requirements:

- 3 states require three Carnegie credits in science,
- 3 states require two science credits and one additional credit in math or science,
- 36 states require two credits in science,
- 2 states require one credit in science,
- 7 states leave the policy decision on course credits to local districts, and
- 16 states have an advanced or honors diploma that requires additional, higher level courses in science.

State Curriculum Frameworks

In the 1980's states became more active in defining the desired content of curriculum in science and mathematics. The 1987 Council survey of state education departments showed that 38 states had a mathematics curriculum framework, or guide, which "establishes goals or standards for instruction" and 38 states had a science curriculum framework or guide. The 1992 survey asked state science and math supervisors to respond to several questions concerning the status of state curriculum frameworks or guides and their uses in states.

Mathematics. A recent action of many states has been to develop or revise state curriculum frameworks and guides in response to the NCTM Curriculum and Evaluation Standards (National Council of Teachers of Mathematics, 1989). Our 1992 survey results show that 41 states have revised, or are revising, their state framework or guide in response to the NCTM Standards and four states are developing state frameworks.

Most of the state frameworks and guides have a role with the design and development of state student assessment programs. In 22 states, the curriculum framework or guide has a "direct" relationship to the state math assessment, according to mathematics supervisors. In these states, the state curriculum framework or guide defines the content topics and skills to be assessed in mathematics. Thus, the student assessment is a direct outgrowth of the state's efforts with providing a structure for curriculum in mathematics.

The state framework or guide has an "indirect" relationship to state math assessments in 10 states. The state curriculum framework or guide defines broad curriculum goals or objectives, and the math assessment is developed or selected to be consistent with the goals or objectives. The Council survey also indicated that five states have a policy which

Table 2
STATE MATHEMATICS CURRICULUM FRAMEWORK OR GUIDE

STATE	State Framework or Guide Revised with NCTM Standards/Date of Completion	Framework or Guide Relationship to Math Student Assessment	Framework or Guide Relationship to Math Texbooks
ALABAMA	Yes/1989	DIRECT	RECOMMEND
ALASKA	Revising/1992	INDIRECT	No
ARIZONA	Revising/1992	DIRECT	RECOMMEND
ARKANSAS	Revising/1992	DIRECT	SELECT
CALIFORNIA	Yes/1991	INDIRECT	SELECT
COLORADO	–	LEARNING OUTCOMES	No
CONNECTICUT	Revising/1993	DIRECT	No
DELAWARE	Revising/1992	DIRECT	RECOMMEND
DIST. OF COLUMBIA	Revising/1992	DIRECT	SELECT
FLORIDA	Yes/1991	LEARNING OUTCOMES	SELECT
GEORGIA	Yes/1988	INDIRECT	RECOMMEND
HAWAII	Revising/1992	INDIRECT	RECOMMEND
IDAHO	Yes/1990	Developing assessment	SELECT
ILLINOIS	Yes/1985;Revising/1994	DIRECT (1994)	No
INDIANA	Yes/1991	INDIRECT	SELECT
IOWA	Revising/1992	Developing new assessment	No
KANSAS	Yes/1990	DIRECT	No
KENTUCKY	Yes/1992	LEARNING OUTCOMES	LEARNING OUTCOMES
LOUISIANA	Revising/1993	DIRECT	RECOMMEND
MAINE	–	–	–
MARYLAND	Yes/1985	DIRECT	No
MASSACHUSETTS	Developing/1994	–	–
MICHIGAN	Yes/1991	DIRECT	No
MINNESOTA	Yes/1991	DIRECT	No
MISSISSIPPI	Revising/1993	DIRECT	SELECT
MISSOURI	Yes/1991	DIRECT	RECOMMEND
MONTANA	Developing/1994	–	–
NEBRASKA	–	–	–
NEVADA	Yes/1992	INDIRECT	RECOMMEND
NEW HAMPSHIRE	–	–	–
NEW JERSEY	Yes/1990	LEARNING OUTCOMES	No
NEW MEXICO	Revising/1992	INDIRECT	No
NEW YORK	Yes/1990	DIRECT	No
NORTH CAROLINA	Revising/1992	DIRECT	SELECT
NORTH DAKOTA	Developing/1992	–	No
OHIO	Yes/1991	DIRECT	No
OKLAHOMA	Yes/1991	DIRECT	SELECT
OREGON	Yes/1987	DIRECT	SELECT
PENNSYLVANIA	–	–	–
RHODE ISLAND	Developing/1993	–	–
SOUTH CAROLINA	Revising/1994	DIRECT	SELECT
SOUTH DAKOTA	–	–	–
TENNESSEE	Yes/1991	DIRECT	SELECT
TEXAS	Yes/1991	DIRECT	RECOMMEND
UTAH	Revising/1992	DIRECT	SELECT
VERMONT	Revising/1993	Developing assessment	–
VIRGINIA	Yes/1988	INDIRECT	SELECT
WASHINGTON	Yes/1991	No Response	No response
WEST VIRGINIA	Yes/1991	LEARNING OUTCOMES	SELECT
WISCONSIN	Revising/1993	INDIRECT	No
WYOMING	Yes/1990	No state assessment	No
TOTAL	Yes/Revising= 41 States Developing= 4 States No= 6 States	DIRECT= 22 States INDIRECT= 10 States LEARNING OUTCOMES= 5 States	SELECT= 15 States RECOMMEND= 9 States

DIRECT = Direct linkage between framework or guide and assessment, i.e. curriculum framework defines content topics and skills to be assessed in math.
INDIRECT = Curriculum framework defines goals or objectives for instruction, and assessment is developed or selected to reflect goals and objectives.
LEARNING OUTCOMES = State has desired learning outcomes, separate from curriculum framework, and the learning outcomes are used to develop the student assessment.
SELECT = Math curriculum guide or framework is used to select state-approved textbooks.
RECOMMEND = Math curriculum guide or framework is used to recommend a list of textbooks, with selection being made by local districts.
-- No state curriculum framework or guide
Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

mandates desired "learning outcomes" in mathematics. The learning outcomes for mathematics are used to develop the state math assessment.

The 1992 survey also asked math supervisors to indicate the relationship between their state curriculum framework or guide and mathematics textbooks. The math framework or guide is used in 15 states to select state-approved math textbooks. In nine states the math framework or guide is used to recommend a list of textbooks, with selection by local districts or schools.

State mathematics supervisors and other state education staff are very active in implementing state curriculum frameworks or guides in local districts and schools. Appendix A provides a state-by-state summary of specific efforts of states to implement mathematics frameworks or guides in 1991.

Science. The 1992 survey results in Table 3 show that 30 states have a state curriculum framework or guide in science and 15 states are currently developing a framework or guide. According to state science supervisors, the curriculum framework or guide has a "direct" relationship to state science assessments in 16 states. The state curriculum framework or guide in these states defines the content topics and skills to be assessed in science. Thus, the student assessment is a direct outgrowth of the state's efforts with providing a structure for curriculum in science.

In seven states, the state framework or guide has an "indirect" relationship to state science assessments. The framework or guide defines broad curriculum goals or objectives, and the science assessment is developed or selected to be consistent with the goals or objectives. The Council survey also indicated that six states have a policy which mandates

Table 3
STATE SCIENCE CURRICULUM FRAMEWORK OR GUIDE

STATE	Science Framework or Guide Date of Completion	Framework or Guide Relationship to Science Student Assessment	Framework or Guide Relationship to Science Textbooks
ALABAMA	Yes/1988	DIRECT	RECOMMEND
ALASKA	Revising/1994	No state assessment	No
ARIZONA	Yes/1990	DIRECT	RECOMMEND
ARKANSAS	Yes/1990	DIRECT	SELECT
CALIFORNIA	Yes/1990	INDIRECT	SELECT
COLORADO	–	LEARNING OUTCOMES	No
CONNECTICUT	Yes/1991	DIRECT	No
DELAWARE	Developing/1994	No state assessment	RECOMMEND
DIST. OF COLUMBIA	Developing/1993	–	SELECT
FLORIDA	Yes/1990	No state assessment	SELECT
GEORGIA	Yes/1988	INDIRECT	RECOMMEND
HAWAII	Revising/1992	INDIRECT	RECOMMEND
IDAHO	Yes/1989	No state assessment	SELECT
ILLINOIS	Yes/1985;Revising/1994	DIRECT (1994)	No
INDIANA	Developing/1992	DIRECT	SELECT
IOWA	Yes/1991	Developing new assessment	No
KANSAS	Developing/1993	Developing learning outcomes	No
KENTUCKY	Developing/1993	LEARNING OUTCOMES	LEARNING OUTCOMES
LOUISIANA	Yes/1991	DIRECT	RECOMMEND
MAINE	–	–	–
MARYLAND	Yes/1985	DIRECT	No
MASSACHUSETTS	Developing/1994	–	–
MICHIGAN	Developing/1992	DIRECT	No
MINNESOTA	Yes/1991	DIRECT	No
MISSISSIPPI	Yes/1986	DIRECT	SELECT
MISSOURI	Developing/1994	DIRECT	No
MONTANA	Yes/1990	DIRECT	No
NEBRASKA	–	–	–
NEVADA	Yes/1985	No state assessment	RECOMMEND
NEW HAMPSHIRE	–	–	–
NEW JERSEY	Yes/1990	No state assessment	No
NEW MEXICO	Developing/1992	INDIRECT	No
NEW YORK	Yes/1987	DIRECT	No
NORTH CAROLINA	Developing/1993	DIRECT	SELECT
NORTH DAKOTA	Developing/1992	–	No
OHIO	Developing/1993	Developing assessment	No
OKLAHOMA	Revising/1992	DIRECT	No
OREGON	Yes/1989	Developing assessment	SELECT
PENNSYLVANIA	Yes/1987	LEARNING OUTCOMES	No
RHODE ISLAND	Developing/1993	No state assessment	No
SOUTH CAROLINA	–	–	–
SOUTH DAKOTA	–	–	–
TENNESSEE	Yes/1990	INDIRECT	SELECT
TEXAS	Yes/1989	LEARNING OUTCOMES	RECOMMEND
UTAH	Developing/1993	DIRECT	SELECT
VERMONT	Developing/1993	No state assessment	–
VIRGINIA	Yes/1986	INDIRECT	SELECT
WASHINGTON	Yes/1991	No state assessment	No response
WEST VIRGINIA	Revising/1992	LEARNING OUTCOMES	SELECT
WISCONSIN	Revising/1986	No state assessment	No
WYOMING	Yes/1990	No state assessment	No
TOTAL	Yes/Revising = 30 States Developing = 15 States No = 6 States	DIRECT = 16 States INDIRECT = 7 States LEARNING OUTCOMES = 6 States	SELECT = 13 States RECOMMEND = 8 States

DIRECT = Direct linkage between framework or guide and assessment, i.e. curriculum framework defines content topics and skills to be assessed in science.
INDIRECT = Curriculum framework defines goals or objectives for instruction, and assessment is developed or selected to reflect goals and objectives.
LEARNING OUTCOMES = State has desired learning outcomes, separate from curriculum framework, and the learning outcomes are used to develop the student assessment.
SELECT = Science curriculum guide or framework is used to select state-approved textbooks.
RECOMMEND = Science curriculum guide or framework is used to recommend a list of textbooks, with selection being made by local districts.
– No state curriculum framework or guide
Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

desired "learning outcomes" in science. The learning outcomes for science are used to develop the state science assessment.

The 1992 policies survey also asked science supervisors to indicate the relationship between their state curriculum framework or guide and textbooks in mathematics. In 13 states, the science framework or guide is used to select state-approved science textbooks. The framework or guide in eight states is used to recommend a list of textbooks, with selection by local districts or schools.

Science supervisors and other state education staff are very active in implementing state curriculum frameworks or guides in local districts and schools. Appendix B provides a state-by-state summary of specific efforts of states to implement science frameworks or guides in 1991.

State Student Assessment in Science and Mathematics

Student assessment programs expanded significantly in the era of state policy reforms of the 1980's. State policymakers saw a need for greater accountability for educational outcomes, and many states approved funds for statewide annual tests in core academic subjects, including mathematics and science.

In 1989, the Council reported that in mathematics, 40 states had statewide achievement tests, 34 had competency-referenced tests, and 18 states required a mathematics proficiency test to be passed prior to graduation. In science, 28 states had achievement tests and 7 states had competency-referenced tests. The 1989 figures showed an increase since 1984 of six states with math assessments and an increase of 15 states with science assessments (CCSSO, 1989).

In Fall 1991, the state directors of student assessment were surveyed by CCSSO to obtain up-to-date information on student assessment programs (Roeber, 1991). The results from the assessment survey were updated by state science and math supervisors in Spring 1992. Table 4 provides an updated list of state science and math achievement tests and competency tests.

State Science and Math Tests: 1992

- 27 states require a science achievement test (unchanged since 1989)
- 46 states require a mathematics achievement test (up by six states since 1989)
- 5 states require a science competency test (down by one state since 1989)
- 21 states require a mathematics competency test (up by two states since 1989)
- For high school graduation, 13 states require a mathematics proficiency test (down by four states since 1989) and 4 states require a science proficiency test (up by two states since 1989).

State tests designed to assess student proficiency at the end of specific mathematics or science courses are required for credit in four states--New York (Regents), Alabama, North Carolina, and Mississippi.

Since 1989, many states have become active in developing alternative methods of student assessment, sometimes called performance assessments or authentic assessments. The types of alternative assessments state education agencies are designing, pilot testing, or implementing include portfolios, open-ended questions, enhanced multiple choice (e.g., use of graphs), and performance assessments. In many states, new initiatives in alternative assessments are developing rapidly, and the list in Table 5 (as of Spring 1992) may already be dated. However, the information does provide a resource list of states that have alternative assessment projects started.

Alternative Assessments in Mathematics and Science: 1992

- Mathematics--20 states are designing, pilot testing, or implementing an alternative method of assessment.
- Science--16 states are designing, pilot testing, or implementing an alternative method of assessment.

Performance assessments or portfolios were being used in 13 state assessment programs in Spring 1992, either on an every pupil basis (at specific grade levels) or with a statewide sample of students. All of these states designed and implemented a performance assessment or portfolio in mathematics or science since 1989.

Table 4
STATE TESTS IN SCIENCE AND MATHEMATICS BY GRADE AND TYPE OF TEST

	State Achievement Tests			State Competency(c) and Proficiency (p) Tests		
	Science	Math	Source	Science	Math	Source
ALABAMA	4,8	4,8	Stanford	—	3,6,9(c),11-12(p) Alg.I	State
ALASKA	—	4,6,8	ITBS	—	—	—
ARIZONA	—	2-12	ITBS	—	—	—
ARKANSAS	—	4,7,10	Stanford	6,8(c)	3,6,8(c)	State
CALIFORNIA	8	3,6,8,12	State	—	9(p)	State/Dist.opt
COLORADO	—	4,7,10	ITBS/TAP ('91-92)	—	—	—
CONNECTICUT	4,8,11	4,8,11	State/NAEP	—	4,6,8 (c)	State
DELAWARE	—	3,8,11	Stanford	—	8,11(p)	District
DIST. of COL.	1-6	3,6,8,9,11	CTBS	—	—	—
FLORIDA	—	4,7,10	4,7 State/Dist. opt.	—	11(c)	State
GEORGIA	2,4,7,9	2,4,7,9	ITBS	3,5,8(c)11(p)	3,5,8(c),11(p)	State
HAWAII	—	3,6,8,10	Stanford	—	10-12(c)	State
IDAHO	6,8	6,8	ITBS	—	8(p)	State
ILLINOIS	4,7,11	3,6,8,10	State	—	—	—
INDIANA	—	—	—	3,6,8,11(c)	1,2,3,6,8,9,11(c)	State
IOWA	—	—	—	—	—	—
KANSAS	—	4,7,10	State	—	—	—
KENTUCKY	4,8,12	4,8,12	State	—	K,1,2,3,5,7,10 (c)	State
LOUISIANA	4,6,9	3,5,7	CAT	11(p)	3,10(p)	State
MAINE	4,8,11	4,8,11	State	—	—	—
MARYLAND	3,5,8	3,5,8	CTBS	—	9(c)	State
MASSACHUSETTS	4,8,12	4,8,12	State	—	—	—
MICHIGAN	5,8,11	4,7,10	State/NAEP	—	—	—
MINNESOTA	6,9,11	5,8,11	State/Dist. opt.	—	—	—
MISSISSIPPI	4,6,8	4,6,8	Stanford	—	5,11(c),Alg.I(p)	State
MISSOURI	3,6,8,10	3,6,8,10	State	—	9(c)	State
MONTANA	3,8,11	3,8,11	State/Dist. opt.	—	—	—
NEBRASKA	3 levels	3 levels	Dist. opt.	—	By 5(c)	Dist.opt.
NEVADA	—	3,6,9	CTBS	—	11-12(p)	State
N. HAMPSHIRE	—	3('93)	State	—	—	—
NEW JERSEY	—	3,6,8,11	3,6 Dist. opt./State	—	—	—
NEW MEXICO	3,5,8	3,5,8	CTBS	—	10(c)	State
NEW YORK	4	3,6	State	9-12(p)9(c)	9-12(p)9-12(c)	State & Regents
N.CAROLINA	3,6,8	3,6,8	State	Courses(p)	3,6,8,10(c),courses(p)	State
NORTH DAKOTA	3,6,8,11	3,6,8,11	CTBS	—	—	—
OHIO	—	4,6,8,10	State/Dist. opt.	—	1-12,(c)9(p)	Dist.opt./State
OKLAHOMA	3,5,7,9,11	3,5,7,9,11	ITBS/TAP	—	—	—
OREGON	—	3,5,8,11	State	—	—	—
PENNSYLVANIA	—	5,8	State	—	—	State
RHODE ISLAND	—	3,6,8,10	MAT	—	—	—
S.CAROLINA	4,5,7,9,11	4,5,7,9,11	CTBS	3,6,8(c)	1,2,3,6,8,10(c)	State
SOUTH DAKOTA	4,8,11	4,8,11	Stanford	—	—	—
TENNESSEE	2-8	2-8	State	—	10(p)	State
TEXAS	—	3-11	State	—	3,5,7,9,11(c)	State
UTAH	—	5,11	CTBS	—	9(p)	State/Dist.opt.
VERMONT	—	—	—	—	—	—
VIRGINIA	4,8,11	4,8,11	ITBS/TAP	—	6-8(c)	State
WASHINGTON	—	4,8,11	CTBS/State	—	—	—
WEST VIRGINIA	—	3,6,9,11	CTBS	—	1-6(c)	State
WISCONSIN	—	—	—	—	3,7,10(c)	State/Dist.opt.
WYOMING	—	—	—	—	—	—
TOTAL	27	46		5(c)4(p)	21(c)13(p)	

Source: State Departments of Education, Assessment Directors, Fall 1991.

Table 5
STATES WITH ALTERNATIVE ASSESSMENTS IN MATHEMATICS AND SCIENCE

State	Subject/Grade	Type of Assessment	Status
ALABAMA	Algebra 1	Performance	5
ARIZONA	Math 3,8,12	Performance	3,4
	Science 3,8,12	Performance	1,2
CALIFORNIA	Math 4,8,10	EMC, Open-ended	4
	Science 5,8,10	EMC, Open-ended	4
COLORADO	Math 4,7,10	Performance, EMC, EPER, Proj.	3
CONNECTICUT	Math 10, 11	Performance, Open-ended	1,2,3
	Science 10, 11	Performance	1,2,3
DIST. OF COLUMBIA	Math 7-12	Performance	3
	Science 7-12	Performance	3
FLORIDA	Planning	–	–
GEORGIA	Planning	–	–
HAWAII	Math 4,8	Performance, EMC	4,5
	Science 3,6,8,12	Performance, EMC	4
INDIANA	Math 10	Performance	4
KANSAS	Math 4,7,10	Performance, EMC,	3, 4
		Open-Ended	5
KENTUCKY	Math 4,8,12	Performance, EMC, Open-ended	1,2,3
	Science 4,8,12	Performance, EMC, Open-ended	1,2,3
MAINE	Math 4,8,11	EPER, EMC	4,5
	Science 4,8,11	EPER, EMC	4
MARYLAND	Math 3,5,8	Performance	5
	Science 3,5,8	Performance	5
	Math/Science 11	Performance	4
MASSACHUSETTS	Math 4,8,12	Open-ended	5
	Science 4,8,12	Open-ended	5
MINNESOTA	Math 5,8,11	Open-ended, EMC	3,4
	Science 6,9,11	Performance, EMC	4
MISSOURI	Science 7	Performance	3
NEW JERSEY	Math 8,11	Performance, Open-ended	4,5
NEW YORK	Science 4	Performance	5
NORTH CAROLINA	Math 3-8	EMC, Open-ended	3
	Science 3-8	Open-ended, Performance	1,2,3
OREGON	Math 8	Performance	5
PENNSYLVANIA	Planning	–	–
TEXAS	Science 9	EPER	3
VERMONT	Math 4,8	Portfolio	4
VIRGINIA	Math	Portfolio, Performance, Projects	1
WEST VIRGINIA	Math 1-6	Performance, EMC	5
	Science 1-6	Performance, EMC	5
TOTAL	Math = 20 states Science = 16 states		

Type of Assessment: Portfolio, Performance, Enhanced Multiple Choice (EMC), Open-ended, Extended Performance (EPER), Projects
Status: (1) Design, (2) Being written, (3) Being tried out, (4) Being used on statewide sampling basis, (5) Every pupil basis.

Source: State Departments of Education, Assessment Directors, Fall 1991, and Science and Mathematics Supervisors, Spring 1992.

State Teacher Certification Requirements

In the early 1980's, national experts identified one of the major problems in science and math education as insufficient preparation of teachers in science and mathematics, particularly at the elementary and middle school levels (Johnston and Aldridge, 1984). Other data showed that many well-qualified science and mathematics teachers were leaving teaching, few new graduates in science and mathematics were going into teaching, and many science and mathematics teachers would be retiring in the 1990's (Aldrich, 1983; Darling-Hammond, 1984). States approved many policy initiatives in the 1980's to improve the preparation of teachers and to attract more talented people into science and math teaching.

The Council's policies survey identified state requirements for teacher certification at the elementary, middle school/junior high, and secondary levels of teaching. Three types of requirements were analyzed: number of course credits in science and mathematics, teaching methods courses specific to science and math, and credits or hours in supervised teaching experience.

Elementary Teacher Certification

As of 1987, 27 states had policies requiring science and math course credits for elementary teaching, and 10 states allowed the requirements to be set by institutions with state-approved teacher education programs. Teaching methods courses in elementary science and math were required by 26 states in 1987.

Among the 51 state education departments represented in the 1992 CCSSO survey, the state policies for elementary certification in science and mathematics shown in Table 6 can be summarized as follows:

Table 6
ELEMENTARY TEACHERS: STATE CERTIFICATION REQUIREMENTS IN SCIENCE AND MATHEMATICS

STATE	COURSE CREDITS: MATH	COURSE CREDITS: SCIENCE	TEACHING METHODS IN SCIENCE/MATH	SUPERVISED TEACHING EXPERIENCE
ALABAMA	9	12	–	9 Sem. Cr.
ALASKA	IHE		IHE	IHE
ARIZONA	6	8	Science & Math	8 Sem. Cr.
ARKANSAS	6	9	Science & Math	12 Wks.
CALIFORNIA	IHE		IHE	IHE
COLORADO	*No State Req.*		Science & Math	400 Hrs.
CONNECTICUT	3	3	–	6 Sem. Cr.
DELAWARE	6	6	Science & Math	6 Sem. Cr.
DISTRICT OF COLUMBIA	9	6	Science & Math	1 Full Sem.
FLORIDA	*No State Req.*		Science & Math	6 Sem. Cr.
GEORGIA	10 qtr	10 qtr	Science & Math	15 Qtr. Cr.
HAWAII	IHE		Science & Math	1 Full Sem.
IDAHO	6	8	–	6 Sem. Cr.
ILLINOIS	6	12	–	5 Sem. Cr.
INDIANA	6	6	Science & Math	9 Wks.
IOWA	*No State Req.*		Science & Math	12 Wks.
KANSAS	*No State Req.*		Science & Math	10 Wks.
KENTUCKY	*No State Req.*		Science & Math	12 Wks.
LOUISIANA	6	12	–	9 Sem. Cr.
MAINE	6	6	Science & Math	15 Wks.
MARYLAND	6	12	Science & Math	12 Sem. Cr.
MASSACHUSETTS	*No State Req.*		–	300 Hrs.
MICHIGAN	*No State Req.*		–	6 Sem. Cr.
MINNESOTA	IHE		Science & Math	1 Full Qtr.
MISSISSIPPI	IHE		IHE	IHE
MISSOURI	5	5	Science & Math	8 Sem. Cr.
MONTANA	9 qtr	9 qtr	Science & Math	10 Wks.
NEBRASKA	IHE		–	520 Hrs.
NEVADA	*No State Req.*		–	1 Full Sem.
NEW HAMPSHIRE	IHE		IHE	IHE
NEW JERSEY	*No State Req.*		Science & Math	1 Full Sem.
NEW MEXICO	6	12	IHE	6 Sem. Cr.
NEW YORK	*No State Req.*		–	1 Full Year
NORTH CAROLINA	IHE		Science & Math	6 Sem. Cr.
NORTH DAKOTA	3	9	–	10 Wks.
OHIO	IHE		–	300 Hrs.
OKLAHOMA	2	2	Science & Math	12 Wks.
OREGON	12	9	Science & Math	15 Qtr. Cr.
PENNSYLVANIA	IHE		IHE	IHE
RHODE ISLAND	*No State Req.*		Science & Math	6 Sem. Cr.
SOUTH CAROLINA	*No State Req.*		–	60 Days
SOUTH DAKOTA	6	4	Science & Math	10 Wks.
TENNESSEE	9 qtr	18 qtr	Science & Math	8 Qtr. Cr.
TEXAS	3	3	–	6 Sem. Cr.
UTAH	IHE		Science & Math	1 Full Qtr.
VERMONT	IHE		Science & Math	IHE
VIRGINIA	6	6	–	6 Sem. Cr.
WASHINGTON	6	6	Science & Math	15 Sem. Cr.
WEST VIRGINIA	IHE		IHE	IHE
WISCONSIN	12	12	Science & Math	1 Full Sem.
WYOMING	6	6	Science & Math	6 Sem. Cr.
TOTAL (states with requirements)	26 states 13 IHE	26 states	29 Science 29 Math 7 IHE	44 states 7 IHE

– No State Requirement
IHE = State-approved program of institutions of higher education.
See footnotes to Table 6 for details on each state.
"Credits" = Semester credits, unless quarter credits specified.
Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

- 26 states require some college course credits in mathematics and 26 states require some college course credits in science (decrease of 1 state since 1987).

- 13 states allow institutions of higher education with approved teacher education programs to set the number of required course credits (increase of 4 states since 1987).

- The course requirements in mathematics vary from 2 semester credits to 12 credits and the median is 6 credits.

- The course requirements in science vary from 2 semester credits to 12 credits and the median is 6 credits.

- 29 states specifically require a course in teaching methods in mathematics and science for elementary certification (increase of 3 states since 1987).

- All states require supervised teaching experience at the elementary level. The survey results show the average state requires 6 to 8 semester credits of supervised teaching experience.

Overall, there has been an increase of three states setting science and math course credit requirements for elementary teaching, either directly or indirectly, through higher education institutions, and the number of states requiring science and math teaching methods has increased by three states.

Secondary Mathematics and Science Teacher Certification

The CCSSO policies survey results show that all states have requirements for certification of secondary science and mathematics teachers, with "secondary" typically defined as teachers in grades 7-12.

In 1987, the median number of mathematics credits required for state certification in math was 24 credits. Forty-two states had a broad-field science certification in 1987. The median number of credits required for certification in biology, chemistry, or physics was 24 credits. In 1987, 11 states allowed higher education institutions with approved programs to set the course credit requirements, and teaching methods in science and math were required by 34 states for secondary certification.

The 1992 survey results on state requirements for secondary certification are shown in Table 7, and can be summarized as follows:

- The course requirements for secondary mathematics certification vary from 18 semester credits (Connecticut, South Dakota) to 40 semester credits (Oklahoma) and 60 quarter credits (Georgia). The median is 27 credits (increase of 3 credits since 1987).

- 36 states have a "broad-field" (or multiple-field) science certification for secondary science (decrease of 6 states since 1987).

- The course requirements for broad-field science certification vary from 21 credits (South Dakota) to 60 credits (Alabama, Ohio, Montana). The median is 30 credits.

- 50 state education departments certify teachers in the specific fields of biology, chemistry, and physics (or physical science). The number of required credits varies from 12 credits (South Dakota, Wyoming) to 46 credits (Maryland). The median is 30 credits (increase of 3 credits since 1987).

- 47 states certify secondary teachers in earth science and 36 states certify teachers in general science.

- In 14 states, the course credit requirements for secondary science and math certification are determined by state-approved programs in institutions of higher education (increase of 3 states since 1987).

- 42 states specifically require a course in teaching methods in science for science certification and 42 states require teaching methods in mathematics for mathematics certification (increase of 8 states since 1987).

- All states require supervised teaching experience at the secondary level. The survey results show the average state requires 6 to 8 semester credits of supervised teaching experience.

Overall, state requirements for secondary science and math teacher certification have gone up slightly. From 1987 to 1992, there was an average increase of three credits (24 to 27) in the requirements for state certification in mathematics or a science field. There are seven fewer states with a broad-field science certification than five years ago, with these states moving to specific-field certification. The number of states that set requirement levels through their higher education institutions has increased from 11 to 14. The number of states requiring science and math teaching methods has increased by six (from 34 to 40).

Table 7 (1)
SECONDARY SCIENCE AND MATHEMATICS TEACHERS: STATE CERTIFICATION REQUIREMENTS

	COURSE CREDITS BY CERTIFICATION FIELD				
STATE	MATH	BROAD-FIELD SCIENCE	BIOLOGY CHEMISTRY PHYSICS	EARTH SCIENCE	GENERAL SCIENCE
ALABAMA	36	60	27	27	60
ALASKA	IHE	IHE	IHE	IHE	IHE
ARIZONA	30	30	30	30	30
ARKANSAS	21	–	24	24	24
CALIFORNIA	IHE	–	IHE (Biological, Physical)	–	–
COLORADO	IHE	IHE	IHE	IHE	IHE
CONNECTICUT	18	–	18	18	21
DELAWARE	30	–	39-45	39	36
DISTRICT OF COLUMBIA	27	30	30	30	36
FLORIDA	30	–	21	21	20
GEORGIA	60qtr	70qtr	40qtr	40qtr	–
HAWAII	IHE	IHE	IHE	IHE	IHE
IDAHO	20	45	20	20	–
ILLINOIS	25	32	24	24	24
INDIANA	36	–	36	36	36
IOWA	24	24	24	24	24
KANSAS	IHE	IHE	IHE	IHE	IHE
KENTUCKY	30	30	30	30	–
LOUISIANA	20	–	20	20	32
MAINE	36	–	36 (Life, Physical)	–	–
MARYLAND	30	–	46	46	–
MASSACHUSETTS	36	36	36	36	36
MICHIGAN	Major(30) Minor(20)	30/20	30/20	30/20	30/20
MINNESOTA	IHE	–	IHE (Biology, Physical)	IHE	–
MISSISSIPPI	IHE	IHE	IHE	IHE	IHE
MISSOURI	30	30	20	20	20
MONTANA	30	60	30	30	–
NEBRASKA	30	56	24	24	–
NEVADA	30	36	30	30	30
NEW HAMPSHIRE	IHE	IHE	IHE	IHE	IHE
NEW JERSEY	30	–	30	30	–
NEW MEXICO	24	24	–	–	–
NEW YORK	24	–	15	36	36
NORTH CAROLINA	IHE	IHE	IHE	IHE	–
NORTH DAKOTA	IHE	IHE	IHE	IHE	–
OHIO	30	60	30	30	30
OKLAHOMA	40	–	40	40	40
OREGON	21/42	45	45	45	45
PENNSYLVANIA	IHE	IHE	IHE	IHE	IHE
RHODE ISLAND	30	30	30	–	30
SOUTH CAROLINA	IHE	IHE	IHE	IHE	IHE
SOUTH DAKOTA	18	21	12	12	18
TENNESSEE	36qtr	48qtr	24qtr	24qtr	24qtr
TEXAS	24	48	24	24	–
UTAH	45qtr	–	69qtr(Bio) 45qtr(Chem,Phys)	69qtr	–
VERMONT	IHE	IHE	IHE	IHE	IHE
VIRGINIA	27	–	24	24	30
WASHINGTON	24	41	34	24	24
WEST VIRGINIA	IHE	IHE	IHE	IHE	IHE
WISCONSIN	34	54	34	34	34
WYOMING	24	30	12	12	12
TOTAL (states with requirements)	37 states 14 IHE	24 states 12 IHE	36 states 14 IHE	34 states 13 IHE	26 states 10 IHE

– No State Certification Available
IHE = State-approved program of institutions of higher education.
See footnotes to Table 7 for details on each state.
Physical Science Certification: Maryland-40 credits, Utah-69qtr credits
"Credits" = Semester credits, unless quarter credits specified.
Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

Table 7 (2)
SECONDARY SCIENCE AND MATHEMATICS TEACHERS:
STATE CERTIFICATION REQUIREMENTS

STATE	TEACHING METHODS IN SCIENCE/MATH	SUPERVISED TEACHING EXPERIENCE
ALABAMA	Science & Math	9 Sem. Cr.
ALASKA	IHE	IHE
ARIZONA	Science & Math	8 Sem. Cr.
ARKANSAS	–	12 Wks.
CALIFORNIA	IHE	IHE
COLORADO	Science & Math	400 Hrs.
CONNECTICUT	–	6 Sem. Cr.
DELAWARE	Science & Math	6 Sem. Cr.
DISTRICT OF COLUMBIA	Science & Math	1 Full Sem.
FLORIDA	Science & Math	1 Full Sem.
GEORGIA	Science & Math	15 Qtr. Cr.
HAWAII	Science & Math	1 Full Sem.
IDAHO	–	6 Sem. Cr.
ILLINOIS	Science & Math	5 Sem. Cr.
INDIANA	Science & Math	9 Wks.
IOWA	Science & Math	12 Wks.
KANSAS	Science & Math	10 Wks.
KENTUCKY	Science & Math	12 Wks.
LOUISIANA	–	9 Sem. Cr.
MAINE	Science & Math	6 Sem. Cr.
MARYLAND	Science & Math	12 Sem. Cr.
MASSACHUSETTS	Science & Math	300 Hrs.
MICHIGAN	–	6 Sem. Cr.
MINNESOTA	Science & Math	1 Full Qtr.
MISSISSIPPI	IHE	IHE
MISSOURI	Science & Math	8 Sem. Cr.
MONTANA	Science & Math	10 Wks.
NEBRASKA	Science & Math	320 Hrs.
NEVADA	–	8 Sem. Cr.
NEW HAMPSHIRE	IHE	IHE
NEW JERSEY	Science & Math	1 Full Sem.
NEW MEXICO	IHE	6 Sem. Cr.
NEW YORK	–	1 Full Year
NORTH CAROLINA	IHE	IHE
NORTH DAKOTA	Science & Math	10 Wks.
OHIO	Science & Math	300 Hrs.
OKLAHOMA	Science & Math	12 Wks.
OREGON	Science & Math	15 Qtr. Cr.
PENNSYLVANIA	IHE	12 Wks.
RHODE ISLAND	Science & Math	6 Sem. Cr.
SOUTH CAROLINA	IHE	60 days
SOUTH DAKOTA	Science & Math	10 Wks.
TENNESSEE	Science & Math	4 Sem. Cr.
TEXAS	Science & Math	6 Sem. Cr.
UTAH	Science & Math	1 Full Qtr.
VERMONT	Science & Math	IHE
VIRGINIA	–	6 Sem. Cr.
WASHINGTON	–	15 Sem. Cr.
WEST VIRGINIA	IHE	IHE
WISCONSIN	Science & Math	1 Full Sem.
WYOMING	Science & Math	6 Sem. Cr.
TOTAL (states with requirements)	33 Science 33 Math 9 IHE	44 states 7 IHE

– No State Certification Available
IHE = State-approved program of institutions of higher education.
See footnotes to Table 7 for details on each state.

Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

Middle Grades Teacher Certification

In 1992, 31 states reported having a policy that establishes a separate certification for teaching at the middle school or junior high level. This number compares with 26 states with a middle grades certification in 1987. States that do not have a separate certification for this level generally certify teachers under elementary or secondary certification. State requirements in science and mathematics for middle grades teaching are listed in Table 8, and are summarized as follows:

- The number of mathematics course credits required for middle school/junior high certification varies from 12 semester credits (Louisiana, South Dakota) to 36 semester credits (Massachusetts). The median is 18 credits (unchanged since 1987).

- The number of science course credits required for middle school/junior high certification varies from 12 semester credits (South Dakota) to 36 semester credits (Alabama, Massachusetts, New York). The median is 21 credits (unchanged since 1987).

- Nine states allow institutions of higher education with approved teacher education programs to set the number of credits for certification (increase of 4 states since 1987).

- A course in teaching methods in mathematics is required by 20 states and 20 states require a science teaching methods course (increase of 10 states since 1987).

- All states with middle grades teacher certification require supervised teaching experience. The survey results show the average state requires 6 to 8 semester credits of supervised teaching experience.

The 1992 total of 31 states with a middle grades certification shows an increase in the role of states in certifying teachers at this level. The number of mathematics and science course credits has not increased on average, but the number of states requiring a math and science teaching methods course has almost doubled in the past five years.

Table 8
MIDDLE GRADES TEACHERS: STATE CERTIFICATION REQUIREMENTS IN SCIENCE AND MATHEMATICS

STATE	SEPARATE CERTIFICATION	COURSE CREDITS MATH	COURSE CREDITS SCIENCE	TEACHING METHODS IN SCIENCE/MATH	SUPERVISED TEACHING EXPERIENCE
ALABAMA	YES	27	36	Science & Math	9 Sem. Cr.
ALASKA	YES	IHE		IHE	IHE
ARIZONA	NO	–	–	–	–
ARKANSAS	YES	18	18	–	12 Wks.
CALIFORNIA	YES	IHE		IHE	IHE
COLORADO	YES	IHE		Science & Math	400 Hrs.
CONNECTICUT	NO	–	–	–	–
DELAWARE	YES	15	–	Math Only	6 Sem. Cr.
DISTRICT OF COLUMBIA	YES	24	30	Science & Math	1 Full Sem.
FLORIDA	YES	21	18	Science & Math	1 Full Sem.
GEORGIA	NO	–	–	–	15 Qtr. Cr.
HAWAII	NO	–	–	–	–
IDAHO	NO	–	–	–	–
ILLINOIS	NO	–	–	–	–
INDIANA	YES	18	18	Science & Math	9 Wks.
IOWA	NO	–	–	–	–
KANSAS	YES	IHE		Science & Math	10 Wks.
KENTUCKY	YES	24	24	Science & Math	12 Wks.
LOUISIANA	YES	12	16	–	9 Sem. Cr.
MAINE	YES	2 Minors		Science & Math	15 Wks.
MARYLAND	NO	–	–	–	–
MASSACHUSETTS	YES	36	36	Science & Math	300 Hrs.
MICHIGAN	YES	30	–	–	6 Sem. Cr.
MINNESOTA	YES	IHE		Science & Math	1 Full Qtr.
MISSISSIPPI	NO	–	–	–	–
MISSOURI	YES	21	21	–	1 Full Year
MONTANA	NO	–	–	–	–
NEBRASKA	YES	15	30	Science Only	400 Hrs.
NEVADA	NO	–	–	–	–
NEW HAMPSHIRE	YES	IHE		IHE	IHE
NEW JERSEY	NO	–	–	–	–
NEW MEXICO	NO	–	–	–	–
NEW YORK	YES	18	36	–	1 Full Year
NORTH CAROLINA	YES	IHE		Science & Math	6 Sem. Cr.
NORTH DAKOTA	YES	IHE		Science & Math	10 Wks.
OHIO	YES	20	20	Science & Math	IHE
OKLAHOMA	YES	18	18	Science & Math	–
OREGON	NO	–	–	–	–
PENNSYLVANIA	NO	–	–	–	–
RHODE ISLAND	YES	18	18	Science & Math	6 Sem. Cr.
SOUTH CAROLINA	YES	IHE		IHE	60 Days
SOUTH DAKOTA	YES	12	12	Science & Math	10 Wks.
TENNESSEE	NO	–	–	–	–
TEXAS	NO	–	–	–	–
UTAH	NO	–	–	–	–
VERMONT	YES	2 Minors		Science & Math	IHE
VIRGINIA	YES	15	15	–	6 Sem. Cr.
WASHINGTON	NO	–	–	–	–
WEST VIRGINIA	NO	–	–	–	–
WISCONSIN	YES	22	22	Science & Math	1 Full Sem.
WYOMING	YES	24	30	Science & Math	6 Sem. Cr.
TOTAL (states with requirements)	YES = 31 states	22 states 9 IHE	20 states	20 Science 20 Math 4 IHE	26 states 5 IHE

Note: "NO" for Separate Certification = State teacher certification for these grades under elementary or secondary certification (Tables 6,7)
– No State Requirement
IHE = State-approved program of institutions of higher education.
See footnotes to Table 8 for details on each state.
"Credits" = Semester credits, unless quarter credits specified.
Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

College Major Required in Science or Mathematics

To ensure that teachers have more college course preparation in the field they will be teaching, some states have established a policy that new teachers at the secondary level must have an undergraduate, or graduate, major in the subject area, such as mathematics or one of the science fields. Thus, these states are acting to cut off a path to secondary-level teaching through completion of only a bachelor's degree with a major in education, such as in mathematics education or science education. Table 9 shows that 22 states currently have policies requiring a major in a science or mathematics field for secondary teacher certification.

Teacher Assessments for Certification

An area of significant change in teacher certification policies in the 1980's was the increase in state-mandated assessments of teacher knowledge and skills. The 1990 State Education Indicators report of CCSSO identified the states with required teacher assessments and what is assessed in each state. The list from that report is re-printed under Table 10. The state totals for each type of assessment are:

- 28 states require Basic Skills assessment
- 27 states require assessment of Professional Skills in teaching
- 28 states require assessment of Content Knowledge of subject area
- 17 states require assessment through In-Class Observation of teaching.

Further information is available from CCSSO on when teacher assessments are given, such as prior to initial/provisional certification or prior to regular/permanent certification.

Table 9
STATE CERTIFICATION REQUIRES A MAJOR IN SCIENCE FIELD OR MATHEMATICS FIELD
(i.e., Major in Education Not Accepted)

STATE	
ALABAMA	Science major for middle certification (4-8) and secondary certification (7-12)
ALASKA	Endorsements are based on major or minor.
ARIZONA	–
ARKANSAS	–
CALIFORNIA	–
COLORADO	Science/Math major for certification grades 5-12
CONNECTICUT	Science/Math major preferred effective July 1993
DELAWARE	Science/Math major for certification grades 9-12
DISTRICT OF COLUMBIA	–
FLORIDA	–
GEORGIA	Number of hours of math required for certification is equal to that of major
HAWAII	–
IDAHO	–
ILLINOIS	–
INDIANA	–
IOWA	Science/Math major for certification grades 7-12
KANSAS	Endorsements based on major or minor
KENTUCKY	Science/Math major not required; minor is required for in-field teaching
LOUISIANA	–
MAINE	Science/Math major required for certification grades 7-12
MARYLAND	–
MASSACHUSETTS	In 1994, Science/Math major required for secondary certification
MICHIGAN	Science/Math major or minor is required
MINNESOTA	Math/Science major required for certification grades 7-12
MISSISSIPPI	In 1994, Science/Math major required for secondary certification
MISSOURI	Science major required for certification grades 7-12
MONTANA	Science/Math major required for certification grades 5-12
NEBRASKA	Science/Math major required for certification grades 7-12
NEVADA	–
NEW HAMPSHIRE	IHE-Science/Math major generally required for certification grades 7-12
NEW JERSEY	Science/Math major required for certification grades 7-12
NEW MEXICO	–
NEW YORK	–
NORTH CAROLINA	–
NORTH DAKOTA	Science/Math major required for certification grades 7-12
OHIO	–
OKLAHOMA	Science/Math major required for certification grades 7-12
OREGON	Science/Math major required under IHE program
PENNSYLVANIA	–
RHODE ISLAND	Science/Math major required for certification grades 7-12
SOUTH CAROLINA	–
SOUTH DAKOTA	–
TENNESSEE	–
TEXAS	Science/Math major required for certification grades 7-12
UTAH	Major not required but 45 hours in the subject
VERMONT	Science/Math major required for certification grades 7-12 (1994)
VIRGINIA	Science/Math major required for certification grades 7-12
WASHINGTON	*No Response*
WEST VIRGINIA	–
WISCONSIN	Science/Math major required for certification grades 6-12
WYOMING	–
TOTAL	22 states require major in mathematics or science

– No State Requirement

Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

Table 10
TEACHER ASSESSMENT FOR CERTIFICATION IN SCIENCE AND MATHEMATICS

STATE	CONTENT OR SKILLS ASSESSED
ALABAMA	–
ALASKA	–
ARIZONA	Basic Skills, Professional Skills
ARKANSAS	Professional Skills, Content Knowledge
CALIFORNIA	Basic Skills, Content Knowledge
COLORADO	Basic Skills, In-Class Observation
CONNECTICUT	Basic Skills, Content Knowledge, In-Class Observation
DELAWARE	Basic Skills
DISTRICT OF COLUMBIA	Basic Skills, Content Knowledge
FLORIDA	Professional Skills, Content Knowledge, In-Class Observation
GEORGIA	Content Knowledge, In-Class Observation
HAWAII	Basic Skills, Professional Skills, Content Knowledge
IDAHO	Content Knowledge, Professional Skills
ILLINOIS	Basic Skills, Professional Skills, Content Knowledge
INDIANA	Basic Skills, Professional Skills, Content Knowledge
IOWA	Basic Skills, Professional Skills, Content Knowledge, In-Class Observation
KANSAS	Basic Skills, Professional Skills
KENTUCKY	Basic Skills, Professional Skills, Content Knowledge, In-Class Observation
LOUISIANA	Basic Skills, Professional Skills, Content Knowledge
MAINE	Basic Skills, Professional Skills, Content Knowledge, In-Class Observation
MARYLAND	Basic Skills, Professional Skills, Content Knowledge
MASSACHUSETTS	–
MICHIGAN	–
MINNESOTA	Basic Skills
MISSISSIPPI	Professional Skills, Content Knowledge, In-Class Observation
MISSOURI	Content Knowledge
MONTANA	Basic Skills, Professional Skills
NEBRASKA	Basic Skills
NEVADA	Basic Skills, Professional Skills, Content Knowledge
NEW HAMPSHIRE	Basic Skills
NEW JERSEY	Content Knowledge
NEW MEXICO	Basic Skills, Professional Skills, In-Class Observation
NEW YORK	Basic Skills, Professional Skills
NORTH CAROLINA	Professional Skills, Content Knowledge, In-Class Observation
NORTH DAKOTA	–
OHIO	Professional Skills, Content Knowledge
OKLAHOMA	In-Class Observation
OREGON	Basic Skills, Professional Skills, Content Knowledge, In-Class Observation
PENNSYLVANIA	Basic Skills, Professional Skills, Content Knowledge
RHODE ISLAND	Basic Skills, Professional Skills, In-Class Observation
SOUTH CAROLINA	Professional Skills, Content Knowledge
SOUTH DAKOTA	–
TENNESSEE	In-Class Observation
TEXAS	Professional Skills, Content Knowledge
UTAH	Content Knowledge
VERMONT	–
VIRGINIA	Basic Skills, Professional Skills, Content Knowledge, In-Class Observation
WASHINGTON	In-Class Observation
WEST VIRGINIA	Basic Skills, Professional Skills, Content Knowledge, In-Class Observation
WISCONSIN	Basic Skills
WYOMING	–
TOTAL (states with policies)	28 Basic Skills, 27 Professional Skills, 28 Content Knowledge, 17 In-Class Observation

– No State Policy

Note: Assessments may be required for Initial/Provisional Certification or for Regular/Permanent Certification.

Source: Council of Chief State School Officers, State Education Indicators: 1990. (See report for more detailed information on teacher assessments)

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Beginning Teacher Induction

In the 1980's, many states developed initiatives to assist the transition of first-year teachers from teacher education programs into full-time teaching. The state policies and programs are often grouped under the term beginning teacher "induction." In the 1992 survey, the following examples of state programs for first-year teachers were listed by science and math supervisors:

Connecticut	Beginning Educators Support in Training--mentor and assessment program for all "first-year teachers."
Dist. of Col.	Beginning teachers assigned a mentor for one or two years
Florida	Beginning Teacher Program for first six months
Georgia	Year long internships and mentor program for first-year certified teachers
Hawaii	Beginning teachers assigned a mentor for one or two years
Indiana	New teachers must complete two semesters of an internship program
Kentucky	New teacher must be part of internship program for one year
New Jersey	Permanent certification after one full year is completed under interim certification
Pennsylvania	Professional development for new teachers
Utah	Internship programs available
West Virginia	Beginning teachers are assigned a mentor for first year

Alternative Routes for Teacher Certification

Another major area of state policy initiatives in the 1980's aimed at improving the quality of teaching was development of alternative ways to obtain state teacher certification. Some state leaders noted that talented individuals with a bachelor's degree, or higher, desired to teach in their field, but did not possess the required education courses. As a means of attracting these individuals into the teaching profession, states established policies to allow individuals to begin teaching, generally under an experienced mentor teacher, while also completing a defined program of study in teacher education.

A study of state alternative certification policies and programs was completed in 1991 by Feistritzer and Chester. Table 11 provides a summary list of alternative certification policies in 38 states, based on the Feistritzer and Chester report. The state policies are categorized under one of four types. All require a bachelor's degree for entry to an alternative certification program, and most involve teaching under a mentor in the same school, and formal instruction in theory and practice of teaching. Some states offer alternative certification in all fields and teaching levels (Type A in Table 11), while others restrict it to shortage fields (Type B). Some states establish all the requirements at the state level while others allow the programs to be designed by school districts (Type C) or higher education institutions (Type D). Additional details on the state programs are described in the Feistritzer and Chester report (1991).

Table 11 (1)
STATE POLICIES ON ALTERNATIVE ROUTES FOR TEACHER CERTIFICATION

STATE	TITLE	TYPE*	INITIAL YEAR
ALABAMA	Fifth Year Master of Arts Program	E: IHE on-campus	1986
ARIZONA	Alternative Secondary Certificate	B: Secondary level	1990
ARKANSAS	Alternative Certification Program	B: Shortage fields	1988
	Probationary Provisional Certificate	D: IHE design	N/A
CALIFORNIA	District Intern Certificate	B: Shortage fields	1984
	University Intern Credential	D: IHE design	1967
COLORADO	Alternative Teacher Certification	A: All fields/levels	1991
CONNECTICUT	Alternate Route to Teacher Certification	A: All fields/levels	1988
DELAWARE	Special Institute for Teacher Certification	E: IHE on-campus	1986
FLORIDA	Temporary Certificate	D: IHE design	1988
GEORGIA	Alternative Certification Program for Critical Shortage Fields	B: Shortage fields	1986
	Alternative Certificate for Selected Special Education Fields	D: IHE design	1987
HAWAII	Special Certification Program Mathematics/Science	E: IHE on-campus	1985
IDAHO	Secondary Field Centered Teacher Training Program	B: Secondary level	1990
ILLINOIS	N/A	D: IHE design	1990
KENTUCKY	Alternative Certification	A: All fields/levels	1991
	Post-Baccalaureate Experimental Secondary Teacher Preparation Program	E: IHE on-campus	1990
LOUISIANA	Alternate Post-Baccalaureate Certification Program	E: IHE on-campus	1990
MAINE	Transcript Analysis	D: IHE design	N/A
MARYLAND	Resident Teacher Certificate	A: All fields/levels	1991
	Creative Initiatives in Teacher Education	E: IHE on-campus	1989
MASS.	Certification Review Panel-- Alternative Route to Certification	C: District or state design	1987
	Apprentice Teacher Program	C: District or state design	1985
MINNESOTA	Alternative Preparation to Teacher Licensure Program	A: All fields/levels	1991
MISSISSIPPI	Alternate Route Provisional Certificate	B: Secondary level	1991
MISSOURI	An Alternate Certification Program	B: Shortage fields	1989

Table 11 (2)

N.HAMPSHIRE	Alternative 5: Provisional Certification Plan	A: All fields/levels	1990
	Alternative 4: Individual Professional Development Plan (Restricted)	C: District or state design	1989
	Conversion Programs	D: IHE design	1989
NEW JERSEY	Provisional Teacher Program	A: All fields/levels	1984
NEW MEXICO	Alternative Licensure	C: District or state design	1986
NEW YORK	Temporary License	D: IHE design	1987
	Internship Certificate	E: IHE on-campus	1963
N. CAROLINA	Modified Certification Plan	C: District or state design	1990
	Lateral Entry Provisional Certificate	D: IHE design	1985
OHIO	Internship Certification Program	B: Secondary level	1990
OKLAHOMA	Alternative Placement Program	C: District or state design	1991
OREGON	Interim Teacher Certificates	C: District or state design	1986
PENNSYLVANIA	Teacher Intern Program	D: IHE design	1960s
S. CAROLINA	Critical Need Conditional Certificate	C: District or state design	1984
S. DAKOTA	Alternative Certification	D: IHE design	1985
TENNESSEE	Interim Probationary License Type C-- Alternative Preparation for Licensure	A: All fields/levels	1990
TEXAS	Alternative Teacher Certification	A: All fields/levels	1985
UTAH	Alternative Preparation for Teaching Program	C: District or state design	1991
VERMONT	License by Evaluation	C: District or state design	1971
WASHINGTON	Internship Program	A: All fields/levels	1991
WEST VIRGINIA	Alternative Program for the Education of Teachers	A: All fields/levels	1991
WISCONSIN	Experimental and Innovative Teacher Education Programs	D: IHE design	1991

*KEY: (Categories defined by Feistritzer and Chester, 1991)

Type A: Program to attract talented individuals with a bachelor's degree in non-education field; involves teaching with a mentor and formal instruction in theory and practice of teaching.

Type B: Same as in Type A, but program is restricted to shortage fields or secondary grade levels or subject areas.

Type C: Program involves individually designed inservice and course-taking, with the state education agency or local school district having major responsibility for program design.

Type D: Same as in Type C, but major responsibility of program design is on institutes of higher education.

Type E: Program at an institution of higher education that involves taking courses on-campus.

Note: This list excludes policies on emergency and temporary certification.

Source: Feistritzer, E. & Chester, D. Alternative Teacher Certification: A State-by-State Analysis, National Center for Education Information (1991) 4401A Connecticut Avenue, NW, #212, Washington, DC 20008. This report provides specific state-by-state descriptions.

Requirements for Renewal of Certification

States have requirements for periodic teacher recertification or certification renewal. Many of these policies were strengthened during the 1980's to specify or increase requirements for continuing education or professional development. However, most states' requirements do not specify that a teacher's further education or development be in the subject area in which the teacher is assigned, such as mathematics or science. Table 12 provides a brief summary of the policies in 41 states for which requirements were reported. A majority of the policies require from 5 to 10 additional course credits every five years.

Advanced Professional Certification

Another area of state policy initiatives aimed at improving teaching and the teaching profession has been to establish a higher level of state certification beyond the regular or standard certification. One purpose for a more advanced certificate is to give teachers professional incentives by recognizing career advancement and experience. Information on the advanced professional certificate was obtained from the 1992 policies survey as well as from the recent Manual of the National Association of Directors of Teacher Education and Certification (NASDTEC, 1991).[1] The two sources show that 28 states offer an advanced professional certificate. In the majority of these states, the requirements are a master's degree or additional course work and two to three years of teaching experience.

[1] For some states, the CCSSO policies survey results had more complete and up-to-date information on advanced professional certification, and in a few states the policy was described only in the NASDTEC Manual.

Table 12
STATE REQUIREMENTS FOR RECERTIFICATION OR RENEWAL OF CERTIFICATION

STATE	
ALABAMA	Approved professional development program
ALASKA	6 semester credits, 3 in upper division graduate levels
ARIZONA	5 semester credits every 6 years
ARKANSAS	Teach 2 of last 6 years in area of certification or 6 credits in subject area
CALIFORNIA	150 clock hours of professional development every 5 years
COLORADO	6 semester credits, 2 of which must be university credit
CONNECTICUT	30 semester credits beyond Bachelors Degree; 90 continuing education credits every 5 years
DELAWARE	6 semester credits after 10 years lapse in not teaching
DISTRICT OF COLUMBIA	6 semester credits every 5 years
FLORIDA	6 semester credits in field every 5 years
GEORGIA	10 qtr credits college or staff development every 5 years
HAWAII	–
IDAHO	6 semester credits every 5 years, 3 of which may be inservice
ILLINOIS	–
INDIANA	6 semester credits every 5 years
IOWA	8 semester credits or 6 semester credits plus 2 years experience every 5 years
KANSAS	8 semester credits with Bachelors Degree or 6 semester credits with Masters Degree every 5 years
KENTUCKY	One year internship, then 4 years to earn 15 semester credits towards Masters Degree
LOUISIANA	–
MAINE	6 semester credits or equivalent every 5 years, preferrably in subject/field
MARYLAND	6 semester credits within 5 years of initial certificate issue
MASSACHUSETTS	–
MICHIGAN	6 semester credits every 5 years
MINNESOTA	12 quarter credits or 125 hours every 5 years
MISSISSIPPI	Every 5 years, 80 staff development credits and 3 semester credits in content area
MISSOURI	6 semester credits professional development plus 30 clock hours of inservice, plus 3 years teaching experience
MONTANA	5 semester credits every 5 years
NEBRASKA	2 years experience, or 6 semester credits and 6 credits professional growth, or locally determined, every 7 years
NEVADA	–
NEW HAMPSHIRE	20 staff development credits each math/science endorsement and 30 credits in general education
NEW JERSEY	–
NEW MEXICO	Must demonstrate competency and be recommended by district superintendent
NEW YORK	–
NORTH CAROLINA	15 semester credits of coursework in subject area every 5 years
NORTH DAKOTA	4 semester credits every 5 years
OHIO	Additional coursework or continuing education units and teaching experience depending on type of certificate
OKLAHOMA	Must teach 3 of 5 years during valid certification and 75 staff development hours
OREGON	For basic license 24 quarter credits every 3 years; for standard license, 45 quarter credits every 5 years
PENNSYLVANIA	–
RHODE ISLAND	After 3 years, 6 semester credits are needed; every 5 years thereafter, 9 semester credits are needed
SOUTH CAROLINA	6 semester credits, 3 of which relate to certification area
SOUTH DAKOTA	6 semester credits every 5 years
TENNESSEE	6 semester credits for BS degree, 5 years and teaching experience for Master's Degree
TEXAS	–
UTAH	3 years teaching within a 5-year period or 9 quarter credits
VERMONT	9 semester credits every 7 years
VIRGINIA	180 hours professional development or 6 semester credits, with 3 hours in current subject every 5 years
WASHINGTON	No response
WEST VIRGINIA	6 semester credits every 5 years; after 2 renewals, certification becomes permanent
WISCONSIN	6 semester credits in a 5 year period or equivalent
WYOMING	5 semester credits every 5 years
TOTAL	41 states with requirements

– No State Policy for Renewal or Recertification

Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992.

Table 13
STATES OFFERING ADVANCED PROFESSIONAL CERTIFICATE FOR TEACHERS

ALABAMA	Master's Degree plus 1 year teaching experience
ALASKA	–
ARIZONA	Master's Degree or 40 semester credits
ARKANSAS	10 years certificate based on graduate degree
CALIFORNIA	–
COLORADO	3 years of successful teaching and Master's Degree
CONNECTICUT	–
DELAWARE	–
DISTRICT OF COLUMBIA	–
FLORIDA	–
GEORGIA	–
HAWAII	A "graduate certificate" represents an additional year of graduate work and higher pay scale
IDAHO	Master's Degree plus 3 years experience
ILLINOIS	–
INDIANA	Master's Degree plus 6 or 12 semester credits in subject area plus 5 years experience
IOWA	Master's Degree and 5 years teaching experience = "professional license"
KANSAS	–
KENTUCKY	–
LOUISIANA	–
MAINE	District recommendation plus 2 years experience
MARYLAND	Standard Professional II = 30 hours and 3 years teaching experience
MASSACHUSETTS	–
MICHIGAN	–
MINNESOTA	18 semester credits plus 3 years experience
MISSISSIPPI	–
MISSOURI	Master's Degree plus 10 years experience
MONTANA	Master's Degree in field plus 3 years experience
NEBRASKA	Master's Degree in the same field as the undergraduate degree
NEVADA	Master's Degree plus 3 years experience
NEW HAMPSHIRE	–
NEW JERSEY	–
NEW MEXICO	Level IIIa-instructional leader requires a Master's Degree & demonstrated teacher competence
NEW YORK	Master's Degree plus 2 years experience
NORTH CAROLINA	Master's, Specialist, Doctorate
NORTH DAKOTA	–
OHIO	Additional course work culminating in a Master's Degree plus 3 years experience
OKLAHOMA	–
OREGON	Master's Degree or 30 semester credits plus 2 years experience
PENNSYLVANIA	34 semester credits plus 3 years experience and district assessment
RHODE ISLAND	Master's Degree in academic field plus 6 years experience at secondary level, 3 must be in state
SOUTH CAROLINA	–
SOUTH DAKOTA	6th year specialist or doctorate
TENNESSEE	–
TEXAS	30 semester credits plus 3 years experience
UTAH	–
VERMONT	–
VIRGINIA	Master's Degree plus 3 years teaching experience
WASHINGTON	Master's Degree or 30 semester credits plus 180 days experience
WEST VIRGINIA	3 years experience plus 6 semester credits
WISCONSIN	–
WYOMING	Master's Degree plus 5 years teaching experience
TOTAL	28 states with advanced professional certificates

– No State Advanced Professional Certificate

Source: State Departments of Education, Mathematics and Science Supervisors, Winter, 1992 and NASDTEC, Manual on Certification and Preparation of Educational Personnel in the U.S., 1991.

SUMMARY

State policies and state policy initiatives continue to shape science and mathematics education in schools. Since the many policy changes in the 1980's, states had few policy initiatives in the areas of graduation requirements and teacher certification from 1987 to 1992. However, state education departments have been very active in revising and developing state curriculum frameworks or guides in science and math, and states have led efforts to develop new methods of student assessment. Currently, 42 states have a state math framework or guide, and almost all have been revised or are being revised with the NCTM curriculum standards. Thirty states have a science framework or guide, and another 14 states are developing a science framework or guide. According to science and mathematics supervisors, a majority of the frameworks are being used to select and develop state student assessments. Almost half the states are planning, designing, or implementing alternative methods of assessment in science or math.

Overall, teacher certification requirements in science and mathematics increased slightly since 1987, with more policy action at the secondary and middle grades levels. The number of states that are certifying secondary science teachers in "broad-field" science declined since 1987 from 42 to 35, and thus more states are certifying in specific science fields. The average number of credits required for secondary science and mathematics certification increased an average of three semester credits (to 27 credits in mathematics and 30 credits in science). Six states added science and mathematics requirements for teacher certification at the middle grades level, up to a total of 31 states. The number of states requiring science and math teaching methods increased by eight states for secondary certification and 10 states for middle grades certification.

For elementary teacher certification, only 26 states require any course credits in science and mathematics, although another 14 states approve programs of higher education institutions which set credit requirements. The state average of six course credits in science and mathematics for elementary teachers means only two college courses are required in each subject. In addition, only 29 states require elementary teachers to take methods courses in how to teach elementary science and mathematics.

The 1992 policies survey showed that 22 states now require a major in mathematics or a science field for secondary certification. These states are trying to raise the subject area preparation of science and math teachers by setting a higher standard for initial preparation. With regard to professional development of existing teachers, over 40 states have specific requirements for renewal of teacher certification, generally on a five-year basis. However, most states set a relatively low standard for enhancing teacher knowledge and skills. Most states require only 5 to 10 additional credits (two to three courses in five years), and less than 10 states specify that the credits must be in the subject area of the teaching assignment. States have been very active in developing policies and programs to establish alternative routes for teacher certification, and the total of 38 states with a policy indicates that there are now many opportunities for non-education graduates to enter teaching.

FOOTNOTES to TABLES

TABLE 1

AL: Alabama Education Improvement Act was passed but not funded. Once implemented, the credit requirements will be 4 for Math and 4 for Science.

HI: Effective, 1997, credit requirements for regular H.S. diploma will be 3 Math and 3 Science.

KS: One of the science courses must be a lab course.

MD: In May 1992, Dept. of Education will vote on increasing science requirements to 3 credits.

MS: In 1995, 3 units of math will be required.

TABLE 2

CA: K-8 Only

DE: In some districts, some texts are correlated with Delaware Standards.

IL: 1985 Framework being revised, to be completed 1994.

IA: Developing a new student assessment to measure outcome-based performance; current assessment has no relationship to current curriculum framework.

KY: Selection of textbooks and materials must support state learning outcomes.

LA: The NCTM standards are used to adopt a list of textbooks for state list while framework is being revised.

MO: Revisions to guide expected in 1994. Core Competencies and Key Skills guide textbook selection by local districts, state does not develop a list of textbooks.

NJ: Learning outcomes are fully coherent with NCTM standards.

NY: Schools are totally autonomous as to text selection, but they usually follow state syllabi.

OK: At state level, list is approved; local level schools may choose from the list with state funds or can select and pay with non-state funds.

TX: A textbook proclamation is written based on the framework.

VT: Currently developing Common Core.

TABLE 3

IL: 1985 Framework being revised, to be completed 1994.

IA: Developing a new student assessment to measure outcome-based performance; current assessment has no relationship to current curriculum framework.

KY: Selection of textbooks and materials must support state learning outcomes.

MA: By 1994, will have direct link to student assessment.

MI: By 1992, will have direct link to student assessment.

NY: State tests at grade 4.

OH: By 1993, will have direct link to student assessment.

OR: By 1991-92, will have direct link to student assessment.

SC: Will have direct link to student assessment when developed.

TN: Will have indirect link to student assessment as developed.

TABLE 4

NJ: State requires standardized testing of all students in grades 3 and 6; districts choose text from state-approved list.
State assesses all students in grade 8 with "Early Warning Test".
In 1994 graduation requirements, statewide assessment of all students in grade 11 will take place.

TABLE 5

KY: Portfolio assessment in math will begin in 1993, and in science in 1994.

MD: Integrated math, science, social studies, reading, writing, language arts, performance-based assessment began May 1992.
11th grade integrated problem-solving assessment being pilot tested.

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TABLE 6

ND: Three science classes required (Biology, Earth Science, Physical Science) and one college level math required.

TABLES 7

MI: A major (30 hrs. credit) or a minor (20 hrs. credit) is required for secondary certification.

MN: All fields are major or minor; Chemistry and Physics are combined for certification under Physical Science field. IHE Broad Field Science for junior high only.

NV: Numbers represent number of credits needed for major area credential. For minor area credential, 16 credits required in Math, Biology Chemistry, Physical Science, Earth Science, or General Science, and 24 credits needed in Broad Field Science.

OR: For Math Field, 21 credits required for basic math, and 42 credits for advanced math.

Four states reported credit requirements for secondary certification in Computer Science:
IN = 4; LA = 18; MD = 24; NV = 16; UT = 45qtr

TABLE 8

GA: Twenty five quarter credits required in one area for primary, and 10 qtr credits in one area for secondary; it does not have to be math or science.

ME: Minimum state requirements for cert. in middle school teaching will require a minor in 2 teaching fields in August 1992.

MO: Student teaching or one year teaching experience under "Supervised Teaching Experience".

VT: Middle school certification requires minors in 2 teaching fields-18 hours each.

WI: Twenty two credits Science and 22 credits Math are proposed to be required.

WY: Only middle school certification requirements; secondary requirements apply to junior high.

TABLES 6,7,8

AL: Supervised teaching experience can also be 15 quarter credits, or 300 Hours, or 10 Weeks.

MA: Three hundred hours supervised teaching experience required, but not all hours have to be in science and mathematics

NJ: No Broad field science certification exists. Effective 1993, new teachers must undergo a full year induction in which full time supervised teaching experience is required before they are granted complete certification.

NC: 20-40% of program in science/math field.

ND: Major or minor required.

WV: Courses matched with job requirements.

VT: Approved institutions of higher education verify acquisitions of required competencies.

TABLE 9

NV: Must have 30 credit hours in math/science for math/science certification (single subject); must have 36 credit hours in multiple subject for multiple subject area certification.

TABLE 12

AL: Depending on the type of certificate, renewal varies:
Class B: valid for 8 years, requires 4 of the 8 years full time teaching, and an approved professional development program.
Class A: Valid for 10 years, requires 5 of the 10 years full time teaching, and approved professional development program.
Class AA: Valid for 12 years, requires 6 of the 12 years full time teaching, and approved professional development program.

KS: Three-year certificate can be renewed to a 5 year certificate with 2 years accredited experience during validity of 3 year certification; Five-year certificate may be renewed with 8 semester hours with Bachelors Degree or with 6 semester hours with Masters Degree.

OH: To renew 4-year provisional certificate: 6 semester hours of coursework, plus 18 continuing education units.
To renew 8-year professional certificate: 12 semester hours of graduate level coursework, plus 36 continuing education units.

Appendix A
Efforts to Implement State Mathematics Framework or Guide in 1991
(from state mathematics supervisors)

ALABAMA	. An implementation guide is being printed. . 10 regional week-long training institutes. . 11 regional teacher inservice centers. . 2-day statewide math conferences for teachers K-6.
ALASKA	. 3-Week summer training program. . NCTM standards will be used to develop new guide.
ARIZONA	. Implementation is mandated by state. . Presentations around state on math essential skills. . New assessment program around essential skills. . Booklets for essential skills developed that provide model for effective instruction.
ARKANSAS	. Act 236 of 1991 restructured the curriculum. . Coordinated staff development program with Eisenhower funds. . Higher Education "Mathematics Crusade" with Eisenhower funds.
CALIFORNIA	. Adoption of the framework.
COLORADO	. NCTM standards being used to develop curriculum. . Eisenhower funds provide staff development opportunities. . "Leading Math into the 21st Century" Conference. . Sample outcomes developed and sent to districts.
CONNECTICUT	. Conferences and summer institutes.
DIST. OF COLUMBIA	. 25 hours of training for elementary teachers on NCTM. . Staff development program for junior high teachers ongoing. . NCTM awareness training for senior high teachers. . Ongoing workshops on implementing NCTM in classroom.
FLORIDA	. Model curriculum/material for K-5 was developed. . Ongoing general inservice activities, none specifically for framework. . Summer inservice institutes. . Eisenhower-funded projects.
GEORGIA	. Teacher resource guides in production. . "Further Definitions" will be out in 1992. . Assessment in grades 3,5,8 has been keyed to framework. . Grade 11 assessment package will be used in 1994. . Local schools in process to implement curriculum.
HAWAII	. Summer institutes. . Conferences for grade level chairs and department heads. . Conferences between higher and lower education math educators. . Inservice activities. . Statewide action plan for improving math instruction. . District and state staff development workshops.
IDAHO	. Used in local, regional, and state inservices. . Used in teacher education at colleges. . Administration inservice. . State goals used in test development. . Disseminated to all schools and teachers.

INDIANA	• Mass mailing of guides to all schools. • Workshops on awareness of guide with hands-on activities. • Assessment indicators realigned to match guide. • Guide explained at NCTM and ICTM meetings. • Course titles and text categories revised to match guide.
IOWA	• Active involvement of ICTM in curriculum review standards.
KANSAS	• Regional staff development through math academy teams. • State assessment developed in grades 3, 7, 10. • New system of building accreditation in math and science. • College math educators group formed.
KENTUCKY	• K-4 Math Specialists. • Activity Centered Elementary Science (ACES)
LOUISIANA	• State Mathematics Coalition. • Leading Mathematics into the 21st Century. • Statewide Systemic Initiative Program.
MARYLAND	• Assessment at grades 3, 5, and 8. • Summer academies for math and science teachers.
MICHIGAN	• State legislation P.A. 25 with incentives for implementing state framework. • Statewide assessment developed. • Statewide professional development.
MINNESOTA	• Preparation of 16 regional teams to implement guide. • Presentations at state/regional meetings.
MISSISSIPPI	• Mandated that districts teach curriculum framework structure.
MISSOURI	• Many regional workshops.
NEVADA	• Trainer of trainer model in second year of progress; trainer completes 32 hours and then teaches staff. • Superintendents and principals trained in summer.
NEW JERSEY	• Prepared resource materials keyed to Common Core. • Service Education workshops, K-3,4-6,7-9, 9-12. • Project PRISM produced model for K-8 Math.
NEW MEXICO	• State conferences focus on NCTM Standards. • Statewide committee revising framework for NCTM.
NEW YORK	• Preparation of trainers/mentors statewide. • Constant workshops by state education agency staff. • Information through professional state journals. • Presentations at local, regional, state meetings.
NORTH CAROLINA	• Eisenhower supported staff development activities. • Summer institutes jointly funded by state education agency and institutes for higher learning. • Forums and small group sessions for curriculum review.
NORTH DAKOTA	• 21st Century Team, introducing NCTM standards to teachers.

OHIO	. Ohio Model for Excellence in Math provides regional professional development. . Summer workshops for elementary teachers. . Regional meeting to introduce model math curriculm.
OKLAHOMA	. Adopting standards in all areas including math.
OREGON	. Eisenhower funding is primary support system for implementation of math framework. . Professional organization workshops and conferences.
RHODE ISLAND	. With Statewide Systemic Initiatives, working on a state curriculum framework.
SOUTH CAROLINA	. Curriculum Congress convened. . Math group developed programs for math. . Writing team appointed for math framework. . Twelve projects developing alternative assessment strategies.
TENNESSEE	. Summer workshops . Workshops on textbook selections based on guide. . System level math specialists being developed. . Development of math activity manuals. . Emphasis on state conferences and workshops.
TEXAS	. Development of staff development modules to train teachers. . Trained several thousand teachers in this module through a network of trainers. . Purchase of 68,000 calculators to distribute to 8th graders across state. . Revised assessment program to be more like curriculum guidelines.
UTAH	. Each district is visited by an implementation team. . Inservice activities based on district needs. . Inservice training for both elementary and secondary teachers. . Regional training for district staff in math. . Presentations by math specialists focusing on implementation.
VIRGINIA	. Copies of frameworks are sent out upon request . Informational meetings. . Presentations at state conferences. . Professional development workshops for mathematics teachers.
WISCONSIN	. Since guide is old, no special efforts made.
WYOMING	. State learner outcomes being developed.

Appendix B
Efforts to Implement State Science Framework or Guide in 1991
(from state science supervisors)

ALABAMA	. Regional week-long training institutes. . 11 regional teacher inservice education centers. . Statewide elementary science assessment initiated. . 7th grade integrated pilot program begun.
ALASKA	. Alaska Science Consortium through universities. . Science/Technology Pilots and Training. . Mini-grants for innovative technical assistance to school districts.
ARIZONA	. Twenty regional science workshops held for districts. . One science leadership colloquium with 40 districts. . Five regional hands-on science symposia involving 139 districts.
ARKANSAS	. State/regional conferences and workshops. . Statewide election; communication network. . Curriculum Development Project: Project ADVISE.
CALIFORNIA	. Implementation conference.
CONNECTICUT	. Conferences and summer institutes.
DISTRICT OF COLUMBIA	. System-wide grade level training. . Ongoing coursework in pedagogy and content. . Special training: Junior High Physical Science, AP Biology, and Vocational Education.
GEORGIA	. Teacher resource guides under development. . State assessment of curriculum in grades 3,5, and 8 in 1992. . Developed grade 11 graduation test based on framework. . Local school system workshops.
HAWAII	. Summer institutes. . Conferences for grade level chairs and department heads. . Conferences between higher and lower education math educators. . Conducted inservice activities. . Statewide action plan for improving math instruction. . District and state staff development workshops.
INDIANA	. Text adoption categories revised to match guide. . Guide explained at Science Teachers Association convention.
IOWA	. No specific efforts. . Guide is available when modifying curriculum. . Guide availability is made known to schools and districts.
LOUISIANA	. Piloting K-8 guides.
MARYLAND	. Assessment at grades 3, 5, and 8. . Summer academies for math and science teachers.
MICHIGAN	. State legislation P.A. 25 with incentives for implementing framework. . Statewide professional development
MINNESOTA	. Regional workshops. . Presentations at regional/statewide meetings.
MISSISSIPPI	. Implementation is mandated by law.

MISSOURI	. Many statewide workshops.
MONTANA	. New certification standards. . New accreditation standards. . Statewide coordinated inservice programs.
NEW JERSEY	. Statewide teacher training. . Business/Industry/Science education meetings. . Advanced seminars for science.
NEW MEXICO	. Framework being revised with input from teachers.
NEW YORK	. Training 97 regional elementary science mentors. . Network of 90 regional middle level mentors. . Training 25 Earth Science Resource agents. . Training 22 Physics Resource agents. . Presentations of syllabi at bureau staff meetings.
NORTH CAROLINA	. Statewide forum on science curriculum revision. . Small group meetings to review curriculum portions.
OKLAHOMA	. Process of developing science standards. . Staff development on learning cycle activities for lab science. . 50% of science is to be laboratory and hands-on. . Sponsored summer workshops with Eisenhower funds. . Statewide workshops on outcome-based education for staff.
OREGON	. Eisenhower funds primary source of support. . Professional leadership organizations enhance goals of the curriculum.
RHODE ISLAND	. Statewide Systemic Inititative grant incorporates development of science framework. . Review of all state frameworks. . Meetings with other science professionals. . Information gathering workshops held in state. . Rhode Island ASCP meeting devoted to math/science curriculum.
SOUTH CAROLINA	. Elementary science leadership program developed to implement science objectives.
TENNESSEE	. Statewide dissemination workshops. . Emphasis of state framework at annual convention. . Development of student activities to complement framework. . Correlation of informal science experiences to framework.
TEXAS	. Meetings with Science Teachers Association of Texas. . State Science Conference. . Texas Science Supervisors Association Meetings.
UTAH	. Each district is visited by an implementation team. . Inservice activities based on district needs. . Inservice training for both elementary and secondary teachers.
VIRGINIA	. Series of workshops over past several years. . Developed a program that assesses factors in environment to bring in line with the framework.
WISCONSIN	. Science World Teacher Training. . Wisonsin Elementary Science Teachers workshop . Superior Science units workshop. . Presentation at Wisconsin Society of Science Teachers
WYOMING	. Outcomes-based model developed.

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